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course, with the object to discover some practicable channel of communication with the natives of the large area of country lying between Lake Nyassa and the coast. A large portion of this country, marked upon the maps as Makua land, is really occupied by the Lomwe. The valley of the Likuga is very thickly peopled, as is indeed the entire country except near the coast where the long continued slave trade has caused depopulation. Mr. O'Neill believes the revered Namuli peak to be an extinct volcano, the upper cone of which has disappeared. The Lomwe of the Likuga are a strong tribe and have a bad character among the slave-dealing traders who are not allowed to pass through their country. Their houses are oblong, strong, and with doors and veranda high enough to be entered without stooping. The only rivers that extend a considerable distance inland between the Zambezi and Lujenda are the Miuli, Ligonya, Mlela and Likugu, but none of these furnish a waterway into the interior, which can, in Mr. O'Neill's opinion, be reached most conveniently from Lake Nyassa and the Shiré.

In a subsequent journey Mr. O'Neill has traced the course of the Ruo river, which has been brought forward as the natural and proper boundary of the Portuguese in this direction.

GEOLOGY AND PALÆONTOLOGY.

THE POSITION OF PTERICHTHYS IN THE SYSTEM.—It is probable that the most primitive type of vertebrate of which we have any knowledge in a fossil state is the genus *Pterichthys*, if vertebrate it can be called. No intelligent attempt has as yet been made to assign this animal to its exact position. The opportunity of examining specimens of the *P. canadensis* Whiteaves, having been afforded me by Dr. A. R. C. Selwyn, director of the Geological Survey of Canada, I give here the results of my examination. Numerous specimens in which the anterior portion of the animal is well preserved, display three important peculiarities. There is a single opening on the middle line above. There are no orbits. There is no lower jaw.¹ The single opening may well be compared with the so-called nasal pouch of the lampreys. The absence of orbits is comparable to the condition in *Amphioxus*. In the absence of a lower jaw it agrees with both the types mentioned.

I have also instituted comparisons with the Tunicate genus *Chelyosoma*, of which the Smithsonian Institution, through the recommendation of Dr. Dall, has liberally placed at my disposal a fine alcoholic specimen from Point Barrow, Alaska. The scutellation of the dorsum of this animal agrees in every detail with that of *Pterichthys*, excepting in some of the small segments

¹ A pair of small, delicate lamini-form bones found beneath the anterior end of the carapace are of uncertain determination.

about the lateral anterior border, and in the intercalated small plates which surround the anus between the first and second dorsal scuta. The anterior orifice is surrounded by six scuta distinct from the marginals, as in *Chelyosoma*. But they are differently arranged in the *Pterichthyidæ*, one forming a median valve of the mouth or *notosome*, and one being embraced in a larger posterior one.

The following hypothesis may be framed to account for these resemblances, which will also probably give *Pterichthys* its true position. The larva of *Chelyosoma* may be reasonably supposed to be caudate and notochordal, as are other *Tunicata*. In this stage its resemblance to *Pterichthys* would be great, especially if it possesses lateral limb-like processes as in *Appendicularia*, placed further forwards than in that genus. Possibly also in this stage the belly will be found to be shielded like the back, which would be

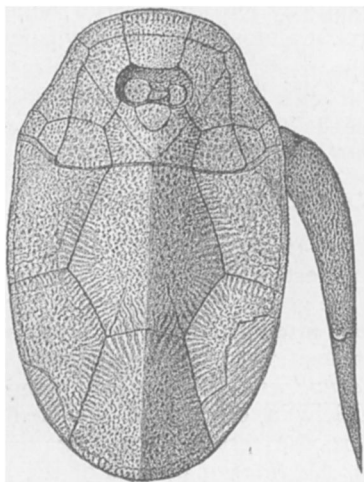


Fig. 1.



Fig. 2.

FIG. 1.—*Bothriolepis canadensis* Whiteaves, from above, half size of a small specimen. The valve of the dorsal mouth, or notosome, is broken. FIG. 2.—*Chelyosoma maclovianum* Brod. & Sow., $\frac{1}{2}$ natural size, from Point Barrow, Alaska.

a still further point of approximation to *Pterichthys*. From such a type I strongly suspect the latter genus to have descended. The principal change which it has undergone has been the substitution of the dorsal anus by the normal vertebrate position at the posterior extremity of the body. The tail has been retained in the European form.

If the above hypothesis be true, the single cephalic opening represents the tunicate mouth, and is the anterior extremity of the alimentary canal. This corroborates the theory that the "nasal pouch" and epiphysis or pineal gland of other vertebrates, represent the primitive mouth and œsophagus, as held by Geof-

ERRATUM.

Page 290, March number, on lines 6 and 18, for
notosome read notostome.

froy St. Hilaire, Owen and Lankester. On the other hand, in view of the absence of orbits, the theory of Ahlborn and Rabl Ruckard that these parts represent a primitive organ of sense or sight, must be taken into account. The close approximation of the orbits in some of the Cephalaspididæ might add plausibility to this opinion. This would require us to believe that *Pterichthys* is a monocus, as it has no interorbital septum, and that the eyes of other Vertebrata have been derived from this single one by division and gradual separation of the halves. Such a view is not confirmed by the embryology of the eye, nor does it necessarily follow from the facts of palæontology. The resemblance between the median orifice of *Pterichthys* and the orbits of the Cephalaspididæ is probably delusive, and the latter family has probably very remote affinity to the *Pterichthyidæ*.

In view of the position of the mouth, it seems to me that this family should be removed from the Craniata to the Urochorda. It is true that the evidence that this orifice is a functional mouth is not entirely conclusive, as the transfer of the extremity of the œsophagus to the opening at the anterior extremity of the carapace may have taken place, as in the case of the anus. But there seems to be little doubt of the homology of the dorsal orifice with the mouth of *Chelyosoma*, and the structural resemblance to it decides in favor of the Urochorda rather than the Marsipobranchii. Among Urochorda it differs from the Tunicata in the position of the anus, which is the normal vertebrate, and not the dorsal orifice of the former division. It will, therefore, form a second order of the class Urochorda, which I propose to call *Antiarcha*.

It may be more than a coincidence that while the *Chelyosoma* is an arctic type, the *Pterichthyidæ* are so far only known from northern regions, Russia, Scotland, and the province of Quebec, Canada.

After an examination of at least fifty specimens of the *Pterichthys canadensis* neither Mr. Whiteaves nor myself have been able to discover any trace of a tail or of its scales. The possibility of this species having absorbed its tail like the Tunicates is increased by the fact that the posterior border of the carapace is not openly concave as in the *P. milleri*, but is regularly rounded as in *Chelyosoma*. I suspect that the *P. canadensis* belongs to a genus distinct from the *P. milleri*, which may, for the present, bear Eichwald's name *Bothriolepis*. The relations of *Coccosteus* to this order are not close, if the restorations given are correct, although it retains the same type of ventral plates.—*E. D. Cope*.

TYPES OF CARBONIFEROUS XIPHOSURA NEW TO NORTH AMERICA.—We have received from R. D. Lacoe, Esq., of Pittston, Pa., for study and identification, a valuable collection of Carboniferous Xiphosura, mostly from the Mazon Creek beds at Morris, Ill. Besides a series of *Euproops danæ*, there is an undescribed spe-

cies of *Belinurus*, and of *Cyclus*, two genera new to this continent; also a new type probably referable to the Merostomata, which may be called *Dipeltis*. From the Carboniferous beds of Pennsylvania there is a new species of *Euproops*. It need scarcely be added that the discovery of these forms, new to our American Carboniferous fauna, is a matter of considerable interest.

Moreover, the specimen of *Cyclus* shows traces of four or five pairs of limbs, apparently of the same nature as those of the larval *Limuli*, proving that *Cyclus* is in reality, so to speak, a tailless Limuloid. We are able also to report the existence of cephalic appendages in *Euproops*, as seen in a well-preserved *Euproops danaë*, received from Mr. J. C. Carr, of Morris, Illinois.

We will add brief descriptions of the new forms, reserving figures, fuller descriptions, and measurements for a future occasion.

Belinurus lacoei, n. sp.—Cephalic shield with a long lateral acute spine on each side extending to a point either opposite or a little behind the middle of the urosome (abdomen), or nearly to the base of the caudal spine. The urosome much more rounded and shorter than in the European *B. reginæ*, being about twice as broad as long. The caudal spine is long and slender, nearly one-half longer than the body, *i. e.*, longer than the whole body by the length of the head. Length of body including caudal spine 33^{mm}. In nodules at Mazon creek, Morris, Ill. Collection of R. D. Lacoe.

Euproops longispina, n. sp.—The median lobe of the cephalic shield is larger in proportion to the entire shield than in *E. danaë*, and the eyes are much nearer the lateral margin. Ocelli distinctly marked (not before observed in the Carboniferous Limuloids), situated on the median ridge of the median lobe of the head, a little behind its anterior termination, and a little in front of a line drawn through the compound eyes. The lateral spines are much longer than in any specimen of *E. danaë* from the Morris, Ill., beds, being long and slender, extending nearly or quite to the base of the caudal spine. No. 214^a Oakwood colliery, Wilkes-Barre, Pa. Length of body without the caudal spine 30^{mm}, breadth 37^{mm}; a smaller specimen (Nos. 215^a, 215^b), from Butler mine, Pittston, Pa. Collection of R. D. Lacoe.

Regarding the position of the Illinois and Pennsylvania beds containing these fossils, Mr. Lacoe writes me: "The horizon of the Pennsylvania specimens of *Euproops* is much higher than that of Mazon creek. The latter is at the very base of the productive coal measures in shale over the bottom seam of coal. The specimen from the Butler mine, Pittston, is from shale over coal 'E' (Mammoth vein), at the top of the lower productive coal measures, about 300 feet above, and that from the Oakwood colliery is either from the same horizon or the bottom of the lower barren measure next overlying it. The shaft from which it was taken, penetrating both the exact position of the rock con-

taining it could not be ascertained when we discovered it in the 'dump' or rock-pile."

Cyclus americanus, n. sp.—In a nodule from Mazon creek, Illinois, received from Mr. Lacoe, I recognize a species of this rather obscure genus which has not before occurred in North America, but is represented in Europe by nine species.

In form *C. americana* is perfectly orbicular, the length being exactly equaled by the breadth. It is regularly disk-shaped, flattened hemispherical, with the edge of the body broadly and regularly emarginate, the margin being thin and flat, and apparently a little wider on the sides than on the anterior or posterior end. Length 14^{mm}, breadth 14^{mm}.

None of the species yet described have had limbs, and nothing was known, so far as we are aware, of the nature of the limbs. Fortunately there are in Mr. Lacoe's specimen traces of four, and perhaps five pairs of limbs, showing that *Cyclus* had short, stout cephalic appendages, which, when extended, reached near the edge of the cephalic shield. They evidently were like the legs of the larval *Limulus* and the *Belinurinae*, though the extremities are not preserved sufficiently well for us to ascertain whether they ended in forceps, as in *Limulus*, or not, though they probably did.

Another fortunate discovery is that of the nature of the cephalic appendages of Euproops. In a nodule received from Mr. J. C. Carr, all the ambulatory limbs, except the first pair, are distinctly preserved, with faint traces of the shorter first pair which have the position and relative size of those of the larval *Limulus* just before hatching. The cephalic limbs of the second, third, fourth and fifth pairs are of nearly the same size, the fifth pair slightly longer, as the tips reach near the edge of the cephalic shield. Each pair is chelate, the forceps being well developed, and distinctly seen in the third and fourth pair. The sixth pair differ from the others as in *Limulus*, and almost exactly correspond to the shape of the larval *Limulus* figured in our first memoir on *Limulus* (our Figs. 23^d, 24^a and 25^a), though perhaps a little shorter. Thus *Limulus* passes through a trilobitic, and afterwards a *Belinurus* stage. The species of *Cyclus* may be referred to a distinct family group for which we propose the name *Cyclidæ*.

Dipeltis diplodiscus, gen. et sp. nov.—This name is proposed for a singular form which is not satisfactorily preserved, so that its exact relations are not readily determinable, though it will be recognizable as a *Cyclus*-like form. The body is suborbicular, flattened, disk-like, sloping regularly and gradually from the median area to the edge; it is divided into two portions; the larger one to be regarded as anterior or the cephalic shield, and the other as posterior, constituting the abdomen (urosome). The edge of the body is very slightly emarginate, not broadly so as in *Cyclus*; nor is the body distinctly trilobate as in the *Limulidæ*, though

unfortunately the median area of the cephalic shield is wanting. The integument is rather thin, showing no traces of segments; its surface may have had a few scattered small tubercles, at least there are slight indications of them. The surface is smooth and shining.

The cephalic shield is nearly twice as broad as long; the posterior lateral angle is well-rounded, with no sign of a lateral spine; in front the edge was probably obtusely rounded; the surface is slightly convex, the disk being low and flat; the hind edge of the shield is moderately concave, the limits between it and the urosome being clearly indicated by a slight, but distinct, regular curvilinear suture.

The urosome is about three-fourths as long as, but equal in width to the cephalic shield. The front edge is somewhat arcuate, so that the projecting anterior-lateral angle is directed a little forward, and is quite free from the lateral angle of the cephalic shield, which turns away anteriorly from it, leaving a triangular space between the sides of the two regions. Posterior edge of the urosome regularly rounded, and with slight margin. No traces of a caudal lobe or spine. Total length 20^{mm}; total breadth 20^{mm}; length of cephalic shield 11^{mm}; breadth 20^{mm}; length of urosome, 9^{mm}; breadth, 19.5^{mm}. Collection of R. D. Lacoe, 2017^{a, b, c}, in a nodule from Mazon creek, Morris, Illinois.

This remarkable animal was disk-like in shape, composed of two regions, the head and abdomen or urosome, which are more distinctly separate than in the Cyclidæ; yet there are no positive characters to separate it from this group, to which we would, for the present at least, refer it, as it is orbicular, tailless, and consists of a broad, large cephalic shield, with a shorter urosome.—*A. S. Packard.*

GEOLOGICAL NOTES.—*General.*—E. Cortese (*Bull. Comit. geol. d'Ital.*, 1882), gives the result of his studies of the geology of N. E. Sicily. The crystalline mica schists and gneiss form mountains continuing those of Calabria; above them lie blackish-gray, pearly, lustrous, folded phyllites, probably Silurian, associated with the granite of Savoca, the felsite of Castelmola, and the tourmaliniferous pegmatite of Cape Calava, and with dolomitic and crystalline limestone. The crystalline mass of Cape Calava is probably Devonian. In the neighborhood of Ali on the east coast the phyllite is followed by quartzite, associated with slates, sandstone and conglomerates. Above these lies the gray limestone, of which Cape Ali is formed, and in other places yellow and violet shales, quartzite, and hornstone are alternated, and these are followed by a reddish quartzite, variously colored shales and gypsum. These may be Permian, they are not in contact with the succeeding trias. The mesozoic beds are not extensive, but are variously developed. The lower trias, muschelkalk and

upper trias exist, the latter commencing with well-developed beds of red and white dolomite. At Cape Taormina Rhætic beds are seen. The various stages of the Lias can be identified by their fossils, and the series is completed by the chalk, which appears only at one spot (Coll. Re.)

Silurian.—At a recent meeting of the Paris Academy of Sciences, M. Daubrée called attention to the discovery, by M. Buneau, in coal belonging to the Lower Carboniferous, of the remains of a species of *Equisetum*, a genus not previously known to occur below the middle coal measures. The remains of the stems occurred with various *Diplothemema* and *Calymmatotheca*, which proved the stage to be the upper grauwacke. The species has been named *E. antiquum*.—M. A. Milne-Edwards announced the discovery in the Silurian of Scotland, of a new scorpion absolutely identical with that which had previously been found by M. Lindstrom in the upper Silurian of the island of Gothland. The only difference is one of sex, the one being male, and the other female.—M. Brongniart recently called the attention of the Paris Academy of Sciences to a fragment of rock belonging to the middle Silurian, and containing the impression of an insect's wing, that of a cockroach, differing from all other blattidian wings, recent or fossil, in the length of the anal nerve, and the width of the axillary field. M. Brongniart called this ancestor of the cockroaches *Palæoblattina penvillei*, and stated that it was more ancient than the scorpion found by M. Lindstrom, since it belonged to the middle instead of the upper Silurian. The insect fauna of Carboniferous age is already known to be large; the beds of Commeny alone have furnished thirteen hundred.

Carboniferous.—M. Ed. Bureau states that the basin of the Lower Loire is probably the only part of France which presents at once the three stages of the Carboniferous formation. The great Silurian depression between Brittany and La Vendée is formed into parallel furrows, of which the central contains coal of the age of the second half of the Lower Carboniferous stage; while the northern was filled with carboniferous deposits at the middle of the middle Carboniferous; the southern at the end of the middle Carboniferous, and finally a bed was deposited above the lowest one toward the middle of the upper Carboniferous stage.

Jurassic.—M. Cotteau has presented to the Paris Academy of Sciences, a new work on Jurassic Echini. This includes the description of the species of *Polycyphus*, remarkable for their small dimensions and their numerous tubercles; also of *Phymechinus*, as yet only found in Jurassic strata, and near *Stomechinus*, which it resembles in its imperforate and non-crenellated tubercles, but from which it is well distinguished by the bigeminal arrangement of its pores.—C. F. Parona (Mem. Accad. dei Lincei, 1883) gives a list of the mollusks and brachiopods of the Lias of the central Apennines.

Tertiary.—M. V. Lemoine compares *Pleuraspidotherium*, a mammal from the Cornaysien fauna of Reims, on the one hand with *Pachynolophus gaudryi*, and on the other with *Phalangista vulpina* of New South Wales. The dental formulæ of *Pleuraspidotherium* and *Phalangista*, are practically identical. The bones of the face are remarkable for the development of the intermaxillaries and nasals, and for the almost complete ossification of the palatine vault. The lower jaw has a broad commissure, as in *Pachynolophus*, and a special development of the posterior branch recalls *Phalangista*, but is not inclined inwards.—M. F. Fontannes catalogues the pliocene mollusks of the valley of the Rhone and of Rousillon. These include 195 species of gastropods, of which 44 are new; and 146 bivalves, of which 24 are new. The same writer describes the shells of the fresh-water and brackish group of Aix in Lower Languedoc, Provence, and Dauphine, 92 species in all, 11 of which belong to *Potamides*, 11 to *Striatella*, 3 to *Melania* proper, 3 to *Ripa*, 14 to *Lymnæa*, and 12 to *Cyrena*.—M. Neumayr (*Neues Jahrb. für Min., Geol. und Palæon.*, 1884) draws attention to the great similarity between the molars of *Tritylodon* Owen, from Cape Colony, and the molar of *Triglyphus*, described by Fraas from a bone bed near Stuttgart.

Quaternary.—A. Mehring (*Kosmos*, 1883) gives faunistic proofs of the former glaciation of North Germany. Against the "drift theory," he urges that the greater portion of the low-lying parts of North Germany are either entirely free from animal remains, or enclose only land and fresh-water forms, which could not have been the case had a diluvial sea existed. Even the finding of marine animal remains in certain spots can be explained by position from southward moving glaciers. The nature of the deposits and other characters shows that the arctic fauna, the remains of which are found, had its home in the surrounding region.

MINERALOGY AND PETROGRAPHY.¹

OPTICAL ANOMALIES IN CRYSTALS OF THE REGULAR SYSTEM.—The two well-known theories generally advanced to account for the action on polarized light, exceptionally exhibited by certain regular minerals (vid. *NATURALIST*, November, 1882, p. 926, and Feb., 1884, p. 184) have recently undergone an important modification due to the discovery by Mallard, that sections of boracite, when heated above 265° C., become perfectly isotropic.² As is now generally known, Mallard, Tschermak and their followers accounted for these optical anomalies by what is termed "pseudo-symmetry," *i. e.*, the imitation, by certain crystals, of a geometri-

¹ Edited by DR. GEO. H. WILLIAMS, of the Johns Hopkins University, Baltimore, Md., to whom all papers for review should be sent.

² *Bull. Soc. Min. de France*, T. VI, 1883, p. 122.